

What is claimed is:

1. A substrate treatment method comprising:

the droplet generating step of generating droplets of a treatment liquid by mixing the treatment liquid with a gas, the treatment liquid droplets having a volume median diameter of 5 $\mu$ m to 40 $\mu$ m; and

the step of causing the treatment liquid droplets generated in the droplet generating step to impinge on a surface of a substrate being treated.

2. A substrate treatment method as set forth in claim 1, wherein the volume median diameter of the treatment liquid droplets is 10 $\mu$ m to 16 $\mu$ m.

3. A substrate treatment method as set forth in claim 2, wherein the gas is supplied at a flow rate of 58 liters/min to 78 liters/min for collision with the treatment liquid in the droplet generating step.

4. A substrate treatment method as set forth in claim 3, wherein the treatment liquid is supplied at a flow rate of about 100 ml/min for collision with the gas in the droplet generating step.

5. A substrate treatment apparatus comprising:

a bifluid nozzle having a casing, a liquid outlet port for discharging a treatment liquid, and a gas outlet port for discharging a gas, the bifluid nozzle being adapted to introduce the treatment liquid and the gas into the

casing, generate droplets of the treatment liquid by spraying the gas discharged from the gas outlet port over the treatment liquid discharged from the liquid outlet port outside the casing, and spout the droplets on a surface  
5 of a substrate;

a liquid flow rate adjusting mechanism for adjusting a flow rate of the treatment liquid to be introduced into the bifluid nozzle;

a gas flow rate adjusting mechanism for adjusting  
10 a flow rate of the gas to be introduced into the bifluid nozzle; and

a controller for controlling the liquid flow rate adjusting mechanism and the gas flow rate adjusting mechanism so that the liquid droplets spouted from the  
15 bifluid nozzle have a volume median diameter of  $5\mu\text{m}$  to  $40\mu\text{m}$ .

6. A substrate treatment apparatus as set forth in claim 5, wherein the controller controls the liquid flow rate adjusting mechanism and the gas flow rate adjusting  
20 mechanism so as to adjust the volume median diameter of the droplets spouted from the bifluid nozzle at  $10\mu\text{m}$  to  $16\mu\text{m}$ .

7. A substrate treatment apparatus comprising:  
a substrate holder mechanism for holding a substrate  
25 being treated; and

a bifluid nozzle comprising a casing having a treatment liquid inlet port for introducing a treatment liquid, a gas inlet port for introducing a gas to be mixed with the treatment liquid introduced from the treatment liquid inlet port, a treatment liquid outlet port for discharging the treatment liquid introduced from the treatment liquid inlet port in a predetermined treatment liquid discharging direction toward a surface of the substrate held by the substrate holder mechanism, and a gas outlet port disposed in the vicinity of the treatment liquid outlet port for discharging the gas introduced from the gas inlet port toward the surface of the substrate held by the substrate holder mechanism, the bifluid nozzle being adapted to generate droplets of the treatment liquid by mixing the treatment liquid discharged from the treatment liquid outlet port with the gas discharged from the gas outlet port in the vicinity of the treatment liquid outlet port outside the casing and spout the treatment liquid droplets on the surface of the substrate held by the substrate holder mechanism, the bifluid nozzle further comprising a spiral gas flow generating section disposed in a gas channel extending from the gas inlet port to the gas outlet port in the casing for generating a spiral gas flow which sheathes the treatment liquid discharged from the treatment liquid outlet port in the treatment liquid

discharging direction.

8. A substrate treatment apparatus as set forth in claim 7, further comprising a movement mechanism for shifting a position of a treatment performed by the bifluid  
5 nozzle on the substrate held by the substrate holder mechanism.

9. A substrate treatment apparatus as set forth in claim 7,

wherein the bifluid nozzle has a treatment liquid  
10 communication pipe portion which provides a treatment liquid channel extending from the treatment liquid inlet port to the treatment liquid outlet port in the casing, the treatment liquid communication pipe portion limiting at least a portion of the treatment liquid channel adjacent  
15 to the treatment liquid outlet port to a linear channel extending in the treatment liquid discharging direction, and a generally annular gas channel defined around the linear channel between the treatment liquid communication pipe portion and an interior surface of the casing,

20 wherein the spiral gas flow generating section comprises a gas flow deflecting member which deflects a gas flow directed toward the gas outlet port along a generating line of the generally annular gas channel into a direction such that the gas flow has a vector component  
25 directed circumferentially of the generally annular gas

channel.

10. A substrate treatment apparatus as set forth in claim 9, wherein the gas flow deflecting member is provided integrally with the treatment liquid communication pipe  
5 portion as projecting from an outer periphery of the treatment liquid communication pipe portion.

11. A substrate treatment apparatus as set forth in claim 9, wherein the gas flow deflecting member is adapted to guide the deflected gas flow toward the gas outlet port  
10 from at least two circumferentially spaced portions of the generally annular gas channel.

12. A substrate treatment apparatus as set forth in claim 9, wherein the spiral gas flow generating section further comprises a generally annular whirl flow  
15 generating portion disposed between the gas flow deflecting member and the gas outlet port in the gas channel in the casing for causing the gas passed through the gas flow deflecting member to flow in the form of whirl flow around the linear channel and guiding the whirl flow to  
20 the gas outlet port.

13. A substrate treatment apparatus as set forth in claim 7,

wherein the bifluid nozzle is adapted to generate and spout the treatment liquid droplets so that a flow  
25 of the liquid droplets extending from the bifluid nozzle

to the surface of the substrate held by the substrate holder mechanism has a contour which has a narrow portion located in the vicinity of the treatment liquid outlet port and a divergent portion diverging from the narrow portion toward the surface of the substrate held by the substrate holder mechanism.

wherein the narrow portion has a shape such that a cross section thereof taken perpendicularly to the treatment liquid discharging direction has an area generally constant along the treatment liquid discharging direction or an area decreasing toward the substrate held by the substrate holder mechanism.